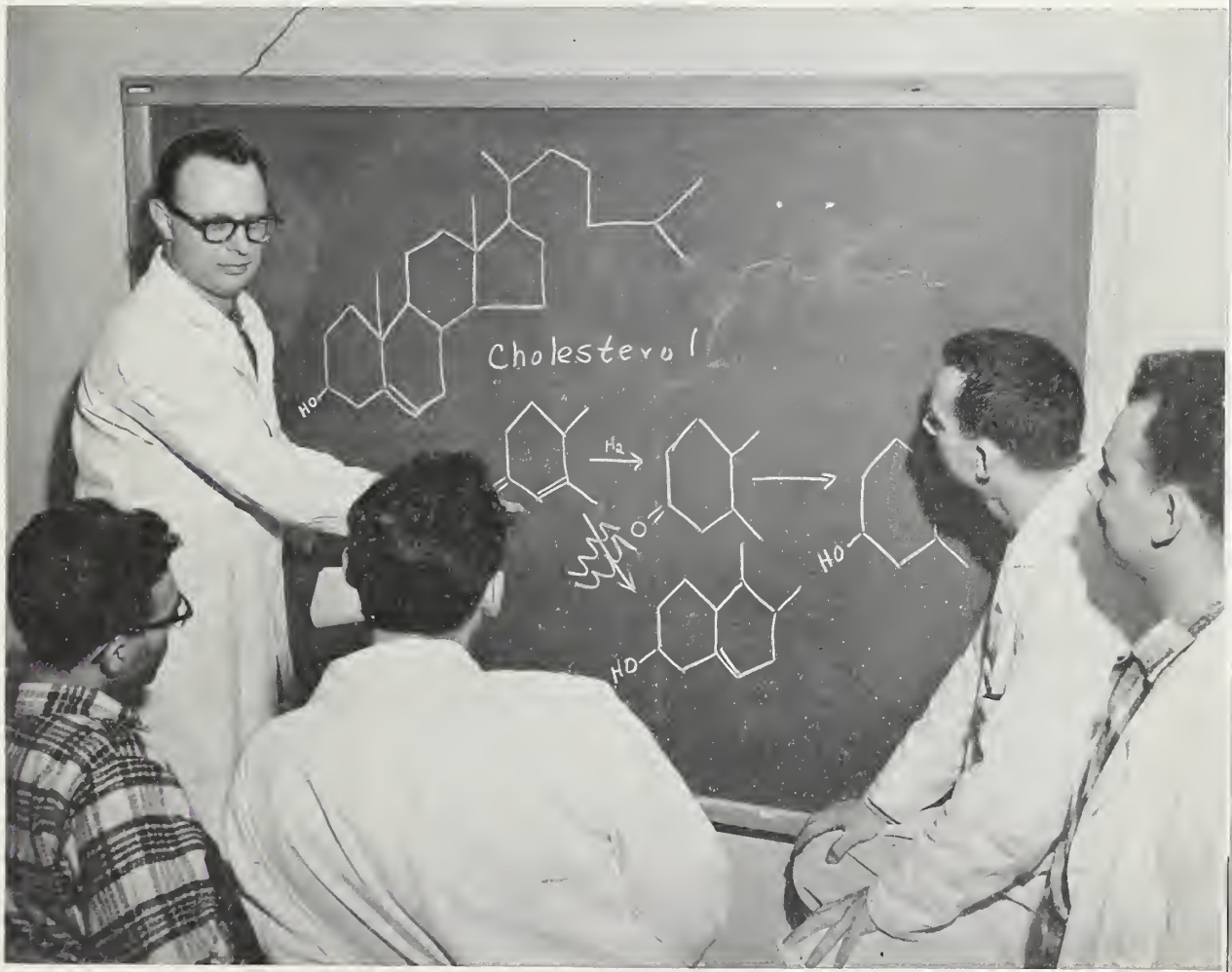
AGRICULTURAL Research

February/1961

United States Department of Agriculture



AGRICULTURAL
Research

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Contents

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Genetics

Recent discoveries in genetics have greatly illuminated man's understanding of the ways in which living systems transmit directions for development and for function from one generation to the next.

During the last decade, scientists have identified DNA (deoxyribonucleic acid) as the essential carrier of hereditary information. They have unraveled the complex interplay—involving DNA, cell proteins, and RNA (ribonucleic acid)—which results in development of living things according to the genetic blueprint in the cells from which they grew.

How this genetic information in the form of DNA is used in the development of a complex organism is clearly a question of fundamental importance to biology. It is enormously difficult. We are far from knowing the complete answer.

In some cases we can narrow the problem of gene action to that of protein synthesis. Not all proteins for which genetic directions are available in the nucleus are synthesized in any one cell. There are ingenious control mechanisms in operation which determine whether the information in a given gene will be used, and if so, when and for how long.

There are now known, in a variety of organisms, many instances in which protein variation is known to be related to particular genes. Hemoglobin protein in man is one. Similar situations are known in viruses, bacteria, algae, fungi, insects, higher plants, mammals, and others.

As we learn more about genetics, it becomes more clear that all creatures communicate biological specifications to their offspring in much the same way. In the case of plants and animals, man has done little of what is potentially possible in the deliberate direction of evolution. This knowledge also applies to the direction of our own evolutionary futures. However, society—not scientists alone—must decide whether we plan man's evolution in any systematic way.

(Highlights from USDA Graduate School lecture by Dr. George Beadle, biochemist, geneticist, and Nobel Prize winner; chairman, Department of Biology, California Institute of Technology.)

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AGRICULTURAL RESEARCH SERVICE
United States Department of Agriculture

Growth Through Agricultural Progress

1975?

Will U.S. farmers in 1975 be able to provide food, feed, and fiber for a third greater population than today's? Can they meet bigger domestic needs and also provide exports to other Nations?

A probable *yes* to both questions, conclude ARS agricultural economists R. O. Rogers and G. T. Barton, in a recent appraisal of our crop production potential. The appraisal is part of a larger USDA study to assess the job of agriculture and agricultural research in meeting future needs.

Findings indicate the challenge to farmers in 1975 will not be a lack of resources, but how to allocate them to achieve a better balance between production and market demand. This challenge, the economists believe, calls for research on more efficient use of all resources within agriculture and more effective resource adjustment between agriculture and nonfarm sectors of the economy.

(*Turn page*)

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1975 (*Continued*)

Data used in the appraisal consisted primarily of (1) projected domestic and foreign demands for farm products in 1975, and (2) increases in crop yields attainable through greater use of present technology. The projections were developed in cooperation with economists in the Agricultural Marketing Service and physical and biological scientists in ARS.

To provide a basis for their analysis, the researchers made several assumptions, including: (1) A 1975 population of 230 million; (2) exports near the high level of 1956; (3) an increase of 10 percent in livestock-feeding efficiency; and (4) economic and other conditions favorable to adoption by farmers of improved practices and higher farm production.

Demand expected to rise 35 percent

Total demand for farm products—including a moderate increase in per capita consumption, plus exports—was projected at 35 percent greater in 1975 than in 1956–58. The needed increase in livestock (45 percent) would be considerably greater than in crops (25 percent). This is due largely to the tendency for consumption of livestock products to rise with income, to the present crop surpluses, and to the projected increase in livestock-feeding efficiency.

Projections on production included two levels of yield per harvested acre for each major crop: (1) *Economic attainable yield*, or that *likely* through greater use of present technology. This yield level takes into account limitations on management, materials, equipment, and capital, as well as past rates of adopting technology. (2) *Economic maximum yield*, or that which *could* be attained with full, efficient, and economic application of present technology.

Analysis of the data indicated that achievement of *economic attainable* yields would provide a 20-percent increase in average crop production per harvested acre above 1956–58. This is not enough to meet 1975 demands, and farmers would require an *extra* 21 million acres (net).

Additional acres would be needed for feed grains (16 million more), hay (5 million), tobacco (1 million), and cotton (5 million). *Fewer acres* would be needed for food grains (4 million fewer), oil crops (1 million), and pasture feed (1 million). Potatoes, dry beans, and sweet potatoes would require about the same acreage as in 1956–58.

Maximum yields are highly unlikely

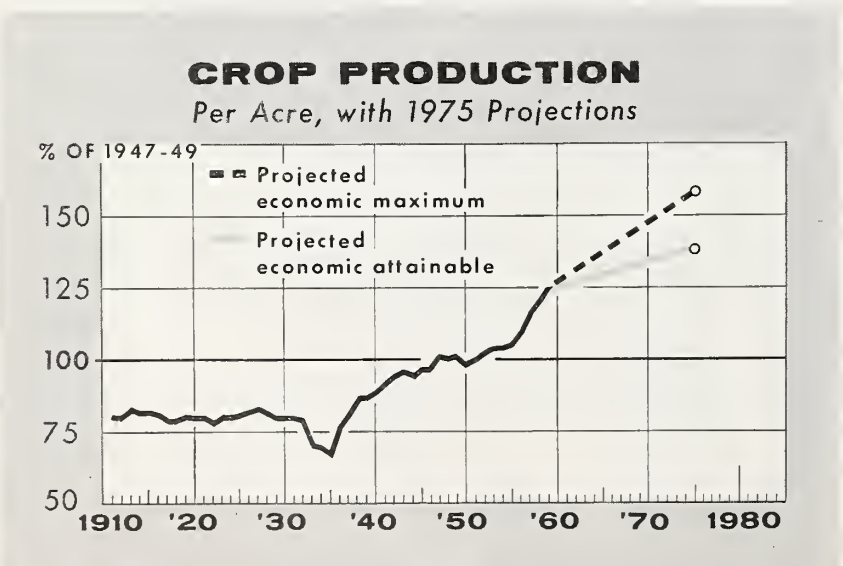
Achievement of *economic maximum yields* would increase production per acre 35 to 40 percent above 1956–58. Farmers could then meet 1975 needs with nearly 27 million *fewer* acres of cropland and 46 million *fewer* acres of pastureland. Considering the assumptions used in the analysis, these economic maximum yields are highly unlikely. But they do indicate the gap between what will *probably* happen and what *could* happen under extremely favorable conditions.

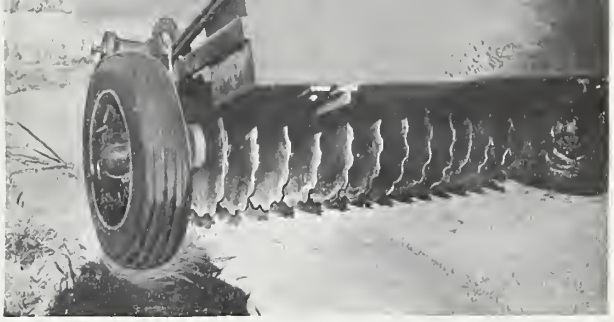
They also suggest that the projected economic attainable yields may be unduly conservative, in view of the increased rate at which farmers are adopting known technology. Several crops are approaching or already equal the yields considered attainable in 1975. Corn, for example, in 1959–60 averaged within 1 bushel of the projected attainable yield.

If, through greater-than-anticipated use of present technology, farmers could close half the 15-percent gap between attainable and maximum yields, they would meet 1975 needs with no additional land. Also, new technology, which could not be taken into account in the projections, may raise yields significantly by 1975.

Many other possibilities exist for increasing farm output. More intensive use could be made of cropland. Livestock enterprises might be shifted to production of types that are more efficient converters of feed. The current trend toward greater specialization in farming is expected to continue. And this, too, will be a contributing factor in greater yields and more efficient production.☆

Trends in 1950's indicate farmers in 1975 can easily match yields projected as attainable with greater use of present technology (shaded line). Yields of some crops are now nearing levels considered attainable with full, efficient, and economic use of current technology (dotted line).





Soil packer with cutaway disks (above) or smooth disks (left) anchored 96 percent of straw or hay mulch on grass-seeded soil. Erect position of disked mulch gave seedlings more light and protection from wind and running water than flat mulch.

ANCHORED MULCH GIVES BETTER PROTECTION

Up to 96 percent of anchored mulch held in winds of 85 miles an hour

■ Straw or hay mulch gives better protection to grass seedings if it is anchored to the ground with soil-packing machines, USDA studies show.

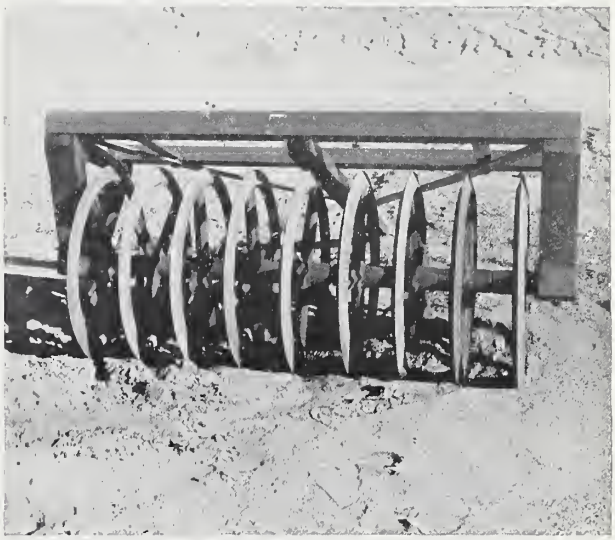
Disk packers (with smooth or cutaway disks spaced not more than 4 inches apart) anchored 96 percent of the mulch against test winds of 85 miles an hour. V-packers anchored 72 percent, plate-punch packers 62 percent, and L-studded packers 52 percent.

The tests were made at Manhattan, Kans., by ARS soil scientist W. S. Chepil and associates, in cooperation with the Kansas Agricultural Experiment Station and the Navy's Bureau of Yards and Docks.

The cutaway and smooth disks proved equally effective on mulch applied at rates up to 2 tons per acre, but the cutaway disks did better on heavier mulch. Soil-penetration and disk-clogging difficulties were overcome by spacing the disks about 8 inches apart for one passage across the field and 12 inches for two passages at right angles to each other. Soil penetration of at least 2 inches but not more than 3 inches was needed to anchor and hold the mulch in high winds.

Easily erodible sandy soils required 3 tons of wheat straw or 2½ tons of native hay per acre for good protection. On less erodible soils, 2½ tons of straw or 2 tons of hay were adequate. Tougher, finer stemmed hay anchored better than smoother, more fragile straw, and long-stemmed hay was better than short.

Seedings on slopes too steep for soil-packing machines can be mulched with straw or hay held by rapid-curing liquid asphalt.☆



V-tread rolling wheel packer failed to punch the mulch firmly into the soil. Even though heavily weighted, it anchored only 72 percent of mulch.

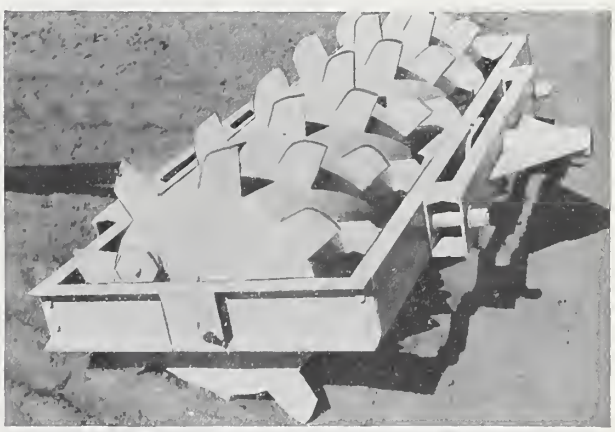


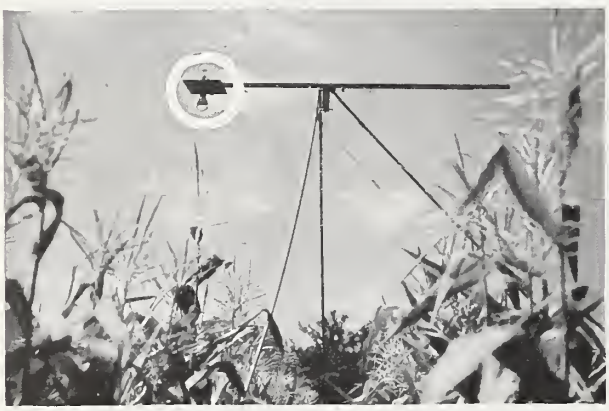
Plate-punch soil packer (above) and the L-rod packer anchored only 62 and 52 percent of the mulch. This did not protect seedlings against strong winds.

Corn growth linked to

Air Movement

Still air on sunny days keeps plants from getting enough carbon dioxide

Anemometers that measure the wind velocity above crops are checked by E. R. Lemon. The bottle-shaped devices gage the air temperature.



Top bulb on net radiometer gages the radiation that comes from sun; lower bulb the radiation from corn. Difference is the radiation absorbed by corn.

Plastic canopy enables study of the environment surrounding the experimental corn plants.

■ Corn yields may be reduced if there is lack of air movement during a number of sunny days—preventing plants from getting sufficient carbon dioxide to sustain maximum growth, say USDA and State scientists.

Research results suggest that the rate of photosynthesis on sunny days is determined largely by the rate of exchange of carbon dioxide (CO_2) between air and corn plants. The plants depend on air turbulence to provide the needed CO_2. About 80 percent of this CO_2 must come from outside the corn field.

Light is another important factor in corn growth, because it strongly influences the use of CO_2 by the plants. As light intensity increases, the amount of CO_2 used also increases. The more CO_2 available, the more the plants use, especially if light intensities are high.

Open and closed environments were used

These findings came from studies directed by ARS soil scientist E. R. Lemon and Cornell University Agricultural Experiment Station agronomist R. B. Musgrave. In evaluating the effects of light and CO_2 on corn growth, the ARS scientists compared measurements from plants in the field with measurements, obtained by the Cornell team, from field plants in an adjacent plastic chamber.

The closed chamber enabled accurate measurement of environmental conditions — temperature, humidity, and changes in amount of CO_2 used when light intensity changed.

Similar measurements were made by the ARS scientists in the corn field. They also measured the amount of solar radiation being absorbed by the crop. Data from the field was then compared with that from instruments inside the plastic growth chamber.

On days with little wind, environmental differences between the growth chamber and the open field were small. Rate of photosynthesis

in both locations increased as light intensity increased.

Late in the morning, the rate of photosynthesis within the chamber leveled off as the maximum rate allowed by the CO_2 level was reached. However, the rate of photosynthesis in the field continued to increase with light intensity—when additional air turbulence made more CO_2 available.

Although considerable quantities of CO_2 are given off in soil respiration, research shows the CO_2 is mixed with the atmosphere at times when corn plants cannot use it. During the 5 or 6 hours of peak demand, the supply of CO_2 from the soil is insufficient. This further indicates that the major supply of CO_2 must come from that stored in the atmosphere.

Increased water loss from plants, caused by increased air turbulence, was not serious. Under favorable soil moisture conditions, rate of photosynthesis increases more rapidly than rate of water loss. In dry areas, however, this loss may be critical.

Air turbulence is influenced by the surface corn presents to wind, which passes smoothly over a field if all plants are about the same height. A rough field, one with plants of different heights, causes the air to "roll," bringing down CO_2-bearing air to the plants.

Roughness changes with wind velocity

This rolling of the air varies as the wind velocity changes, research indicates. In earlier aerodynamic studies, scientists used relatively low-growing crops. These plants presented a constant degree of roughness to the wind. However, taller plants are very elastic, even when the wind velocity is low. A field of tall plants "roughens" as the wind velocity increases.

The surface of a field can be roughened by planting rows at right angles to the wind, or by planting a row of taller plants every few rows.☆

BALING COTTON FOR TEMPORARY STORAGE

■ Using hay baling equipment to bale cotton so it can be stored temporarily prior to ginning may aid in relieving gin yard congestion at the height of the harvest.

Seed cotton, of about 7 percent moisture content, was so baled and stored up to 3 months with little loss of quality. Work was done at USDA's Southwestern cotton ginning laboratory, Mesilla Park, N. Mex.

Many gins are designed to operate at capacities determined by the delivery rate of hand-picked cotton. Conversion to mechanical picking is intensifying the harvest and crowding gin yards with cotton.

In order to handle this cotton before its quality drops, gin operators work at faster rates and process each lot of cotton for a shorter time. A satisfactory method of temporarily storing the cotton would permit processing at slower rates that are best for producing high-quality lint.

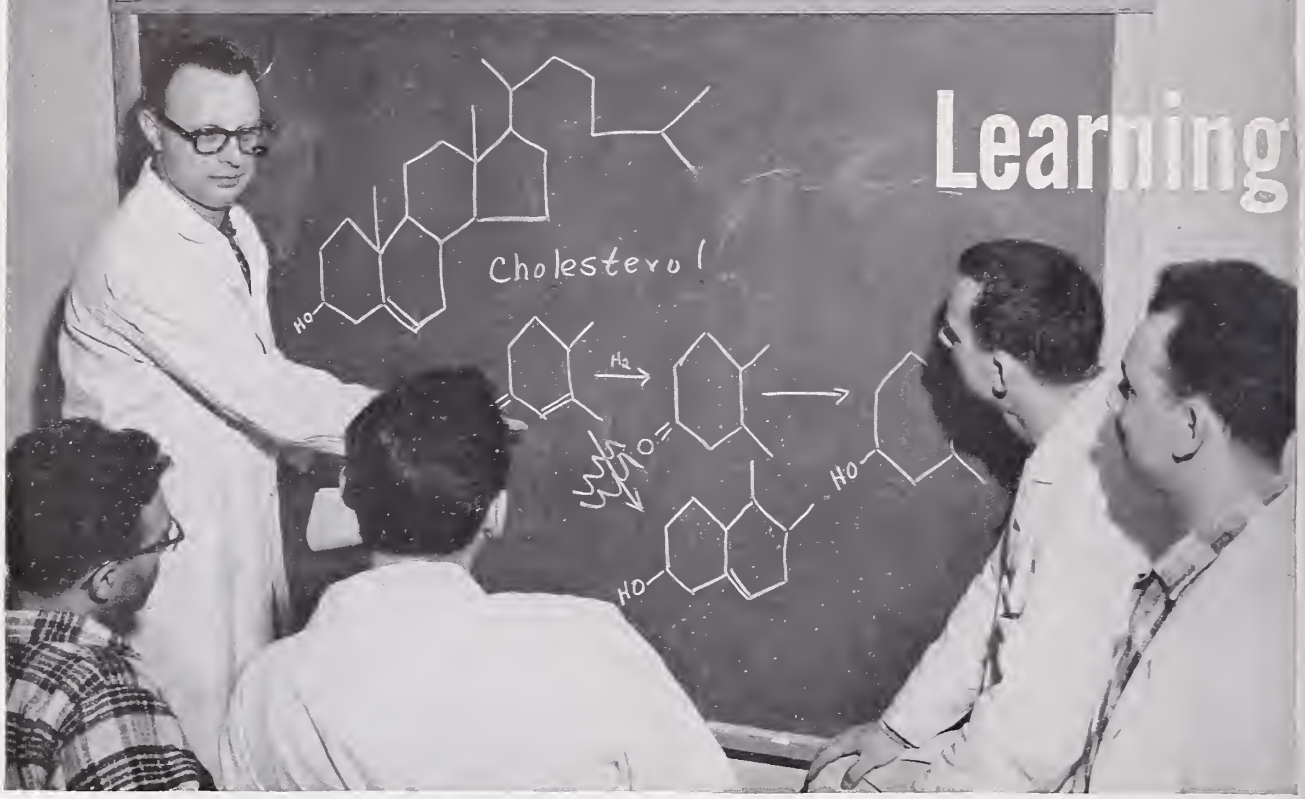
Baled seed cotton would be easier than bulk cotton to handle and store. High-moisture cotton in bales of lower than normal densities might be dried with hay-drying equipment. Baled cotton could be hauled from the field on flat-bed trailers and unloaded with fork-lift trucks. Bales could be lifted to the top of the gin stand with an endless-belt conveyor that would be cheaper to operate than conventional pneumatic systems.

ARS agricultural engineers used a hay baler on one lot of seed cotton; a gin press made another lot into half-sized bales. Results were similar for both baling methods.

After storage 1, 2, and 3 months, the cotton was ginned and graded. Cotton stored 3 months graded lower than comparison cotton ginned immediately after picking. But there was little difference in the grade of the comparison cotton and that stored 1 and 2 months.

Cotton baled at moisture contents higher than 10 percent graded lower and didn't clean as efficiently as low-moisture baled samples.

The influence of baling and storing on quality needs more investigation before recommendations can be made. Practical costs of baling and handling also have to be figured.☆



Molecular structures of cholesterol and some related steroids are diagrammed by W. E. Robbins

Pioneering research is providing information that may help us develop new insect controls

■ Do adult insects need cholesterol in their diet and, if so, how is it used?

Answers to these and related questions are coming out of pioneering research at USDA's Insect Physiology Laboratory at Beltsville, Md.

This work is adding to basic knowledge by helping us understand the role of sterols (fat-like substances) in living systems. And the findings may point to important biochemical links in the chain of insect development. Such information may be exploited by scientists working on insect control.

Cholesterol occurs in all animal tissues, notably in the nerves and brain, bile, gallstones, egg yolk, liver, and spleen. It is a complex molecule which mammals can make in their bodies from simpler materials.

These cholesterol A metabolism studies, using adult houseflies and cockroaches, were made by ARS entomologists W. E. Robbins, J. M. Kaplanis, R. E. Monroe, S. J. Louloudes, and L. A. Tabor.

They first wanted to know whether adult insects can make their own cholesterol. To find out, the entomologists injected radioactive sodium acetate into insects. (Sodium acetate is used by higher animals to make cholesterol.) Neither flies nor cockroaches used the acetate for cholesterol synthesis, confirming that insects must obtain this substance already formed from dietary sources.

What did the insects do with the cholesterol they received? They hoarded it. When C^{14} (radioactive) cholesterol was injected into houseflies, they excreted only 2.0 to 2.6 percent during 3 days after treatment. Rats have been reported to excrete proportionately 10 times this amount.

From 76 to 79 percent of the injected material—much of it unchanged in form—was recovered from the bodies of female flies and their eggs 3 weeks after treatment. More than half was in the eggs, with one-third converted into provitamin D.

bout Cholesterol in INSECTS

Insects are injected with or fed radioactive cholesterol to determine how it is used.

Kept in screen cages with food and water available, flies lay their eggs in saturated cotton held in muslin bags in petri dishes.

Diapers of tiny filter paper discs were attached to flies to collect excreta (top and bottom views).

How do insects metabolize cholesterol? Differently than mammals do, this research shows. Higher animals convert the sterols into bile acids. Insects apparently turn very little cholesterol into bile acids, because there were only trace amounts of C^{14}-labeled acidic compounds in the feces. Also, the feces showed little coprostanol—a product formed during mammalian digestion of the sterol.

Since a large amount was found in the eggs, is cholesterol essential for egg production and hatchability? The number of eggs produced was not markedly affected by intake but hatchability was—only about 21 percent of the eggs from cholesterol-deficient flies hatched, compared to more than 90 percent of the eggs from cholesterol-fed flies.

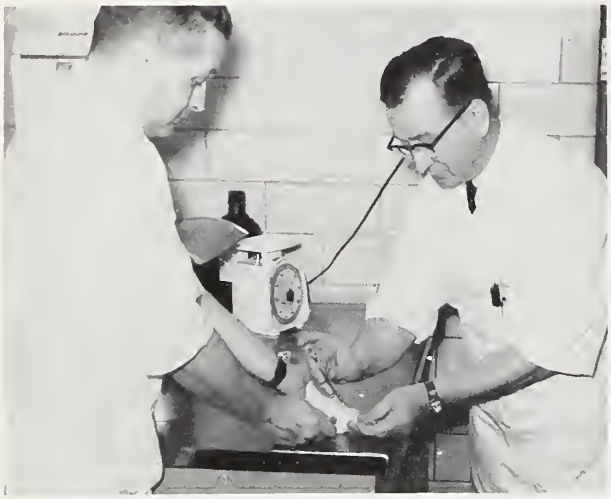
Without this sterol the first hatch was less, and hatchability decreased until by the fourth egg collection it approached zero. At this time there was no indication of embryo development in the eggs. (Apparently the female had exhausted her reserve of cholesterol.) If the flies were given cholesterol, the hatch increased progressively until by the ninth collection it was 83 percent—similar to that of the controls. Hatchability was not affected when 3-day-old males fed a standard diet were placed in cages with females surviving the 22-day experimental period.

How about survival of larvae from cholesterol-deficient flies? Such larvae were weak and many died in the egg or during emergence. Only half of the hatched larvae grew to adulthood, even on a diet containing sufficient sterols to support growth. About 90 percent of the larvae from the control flies became adults.

Cholesterol did not affect length of adult life of the flies. The percentage of flies, with and without cholesterol, surviving for the 22-day experimental period was about the same.

But how does cholesterol exert such important affects on the growth and reproduction of insects? Perhaps, in part, it serves as a hormone precursor as it does in higher animals. This and several other questions—including the use and metabolism of plant sterols by insects and the sites or organs involved in sterol storage and metabolism in insects—are currently under study by the entomologists.☆

OBJECTIVE: Better Protection Against RABIES



To test vaccine potency, veterinarians C. E. Phillips and D. L. Croghan (left) first vaccinate guinea pigs against rabies. Later, rabies virus is injected into the pigs. Phillips (below) then checks pigs. If many show paralysis, vaccine is considered impotent.

■ Increased public protection against rabies is the aim of our recent efforts to ensure availability of stable vaccines for treating dogs.

Some of the modified live-virus type of rabies vaccine has been found substandard in potency by ARS animal biologics inspectors. Intensified testing of rabies vaccines began in 1959.

As a result, USDA recently had manufacturers withdraw their vaccines from wholesalers. Some of the vaccines were permanently removed from the market. Other vaccines were relabeled with a shortened expiration date and again released for sale.

More than 3½ million doses of rabies vaccine (with an estimated value of more than a million dollars) are marketed annually by 15 USDA-licensed manufacturers.

The marketing period previously permitted was 12 to 18 months from the end of satisfactory testing. (Testing usually requires 6 weeks to 3 months after production.) This marketing period has been cut to 12 months from date of production for some manufacturers, 7 months for others. For some, no permissible period has been set, pending further investigations.

These periods were decided upon following more rigorous testing. Each company tested its vaccine three times—prior to release, then 5 to 6 months later, and again at expiration date. The new action relieves manufacturers of the intermediate testing procedure.

Additional testing, conducted since 1959 by ARS inspectors at Michigan State University, East Lansing, will be transferred to the National Animal Disease Laboratory when it opens at Ames, Iowa. This testing provides scientific evaluation of vaccine quality, and permits development and refinement of testing procedures.

The changed marketing periods affect vaccine of chick embryo origin only. The phenol-killed type of vaccine is not affected.☆

Here's an Aid For Pricing Feeder Cattle

■ Now there's a better aid for estimating the premium price feeder cattle with inherited ability to gain rapidly should command over animals of average gaining ability, if both have equal carcass-quality potential.

Compared in making the estimate are: (1) Amount of feed consumed; (2) feed price; (3) how much the animals gain per day; and (4) how many days it takes them to reach marketweight.

Breeders know that some cattle inherit the ability to gain weight rapidly and efficiently. Proving bulls for rate of gain is common. Results of these

tests are usually well-publicized in advance of sales. But the premium paid for steers sired by these bulls is not uniform.

Aid came from much research

The pricing aid was suggested by analysis of data from 10 years of feeding trials by USDA at Front Royal, Va., and the Virginia Agricultural Experiment Station at Blacksburg. Heading the studies were geneticist C. M. Kincaid of ARS and animal husbandman J. S. Gaines of the Virginia station.

Although fast-gaining beef cattle eat more each day, their more efficient use of feed reduces feed costs. The researchers found that beef bulls and steers—with ability to gain weight rapidly—consumed *less feed* per hundredweight of gain and reached marketweight in *less time* than cattle of average gaining ability. Fast-gaining animals used a greater percentage of feed for growth; slow-gainers used more for body maintenance and less for gaining. And in these studies, fast-gaining animals produced higher grade carcasses than average-gainers.

Feeding trials at Front Royal showed that bulls gaining 2¼ pounds a day on full feed needed 7 percent less total feed to reach marketweight than those gaining 2 pounds a day. Animals gaining 2 pounds a day needed 7 percent less total digestible nutrients (TDN) to reach marketweight than those gaining 1¾ pounds.

Similarly, during steer feeding trials at Blacksburg, 11 percent less TDN was needed for each increase of ¼ pound in the average daily gain.

Experiments at Fort Reno, Okla., are one demonstration of how bulls differ greatly in their ability to sire profitable offspring. Calves sired by one bull were worth $10.68 more per head at weaning than other calves from comparable dams and a different bull. Steer progeny of the better bull returned $10.07 more per head at the feedlot. This research was conducted by animal husbandmen D. F. Stephens of ARS and Doyle Chambers of the Oklahoma Agricultural Experiment Station.

Gaining efficiency was the key

Part of the price difference was due to variations in slaughter grades. But much of it was due to faster, more efficient weight gains.☆

NEW TECHNIQUE PUTS US AHEAD OF ASF

■ A major contribution to more successful control or eventual eradication of African swine fever (ASF) is the recent discovery of a laboratory method of diagnosing the deadly disease.

Should the fever appear in the U.S., the diagnostic technique will aid scientists in differentiating it from hog cholera—a similar disease. Such knowledge can assist in efficient and swift control to prevent spread of the disease through our swine.

The method of diagnosis was developed during continuing USDA research in Africa to find more effective controls for ASF. This swine disease, which recently spread from Africa to Spain and Portugal, has never been found in the Western Hemisphere.

The studies showed that ASF virus will grow on swine blood cultures or bone marrow, and cause red corpuscle clumping and cell death. Hog cholera virus doesn't produce a like effect. Previously, there was no positive laboratory method to differentiate between the two viruses.

We haven't been able to develop an effective vaccine against ASF. Further complicating ARS research efforts, 20 strains of the disease have been isolated.

One strain of ASF virus has been modified, making it less deadly. A fairly high percentage of test swine survived inoculation with this virus. Most of the animals remained carriers, but lived when inoculated with a virulent dose of the same strain. Two carrier pigs died after being inoculated with other isolated strains of the virus.

Attempts to control the disease have been moderately successful. For instance, in Kenya there have been only two outbreaks in the last 10 years. Swine production in Africa has been a relatively small, isolated industry. But with production expanding, future outbreaks are possible. Controls consist of isolation, quarantine, and infected animal disposal—methods similar to those used against hog cholera in our country.

The recent outbreaks in Spain and Portugal are the second reported outside the African continent. The first outbreak was in Portugal about 2 years before the present outbreak. ASF has been troublesome in Africa since it was first encountered in 1910.

African wart hogs (Phacochoerus) are believed to have originated the disease. These hogs are also carriers, but more research is needed to reveal how the disease is transmitted to domestic swine. Once established in domestic stock, the virus spreads quickly by contact. Mortality approaches 100 percent, although a few animals survive and remain carriers.☆

WOOL MEASURING IS FASTER NOW

Experimental tool arranges fibers in parallel, permitting more rapid gaging of diameters

■ Measuring the fineness of wool fiber sections, an important criterion in estimating the relative quality of fleeces, is now accelerated by use of a new instrument developed by USDA and cooperating scientists.

Instrument operates electrostatically

This experimental tool—an electrostatic fiber-alignment device—arranges fibers in parallel, simplifying their measurement. Mean diameter and range of diameters of individual fibers can be determined more rapidly. These measurements, key factors in determining the best uses for lots of wool, are also important in comparing and evaluating the quality of fibers produced by individual sheep in breeding experiments.

The new instrument has possibilities for use in aligning other kinds of fibers previous to measurement.

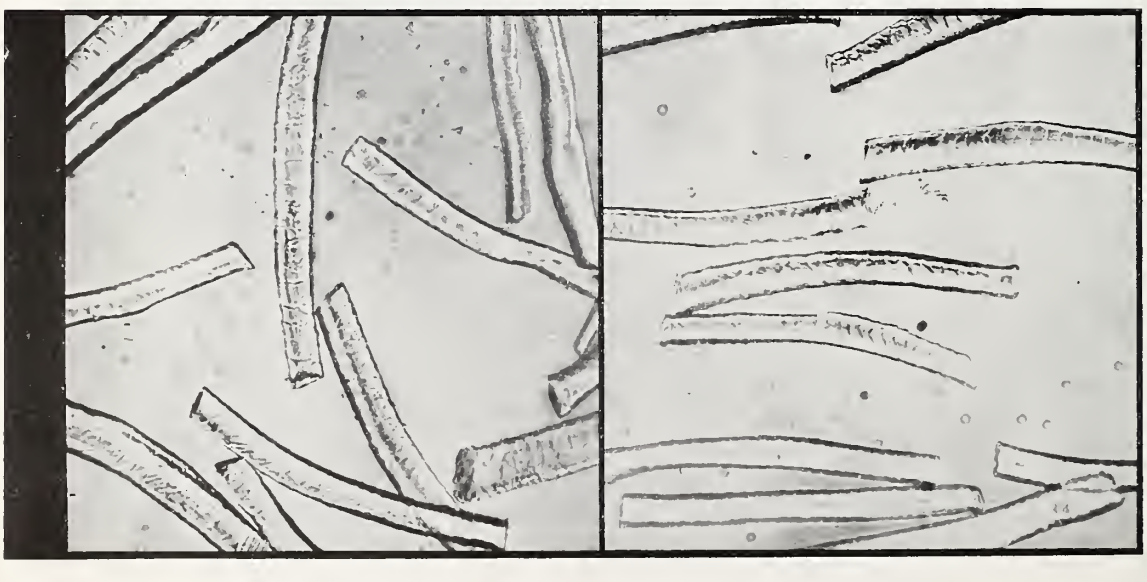
In the past, when our technologists mounted fibers on a glass slide, the minute strands crisscrossed at various angles. Then the slide was placed in a microprojector (a type of electric-lamp projector used to produce, by a standard magnification, an image larger than the actual fibers). A wedge scale, a special rule for measuring the fibers, then needed to be turned constantly to arrive at the same angle with each fiber to get an accurate reading. This was tedious and time-consuming.

Now when fibers are mounted in oil on the slides, the new instrument aligns the fibers electrostatically. Fewer turns of the wedge scale are needed while moving it across the projected images of the wool fibers.

The fiber alignment device was developed, through contract with the Special Instruments Laboratory, Knoxville, Tenn., by engineer H. G. Neil in collaboration with Mary E. Hourihan, ARS wool fiber technologist at Beltsville, Md. H. D. Wood, Jr., Wool Associates of the New York Cotton Exchange, Inc., Boston, Mass., assisted in testing the instrument.

Device contains three main elements

It consists of: (1) A chassis containing a high-voltage transformer, a sample chamber, and indicating lamp; (2) a slide holder to keep the slide and mounting medium from touching the bottom of the sample chamber; and (3) a cover plate to protect the operator from high voltage.☆



The crisscrossed pattern of mounted fibers (left) once complicated their measurement. Now fibers are aligned (right) by a new research tool.

New line aids

Spinach Breeding

■ A new spinach line that's adapted to breeding because it transmits desirable characteristics, especially resistance to mosaic (cucumber virus I) and damping off, has been developed by USDA and the Texas Agricultural Experiment Station.

Mosaic resistance is particularly important in warm spinach-growing areas of the country. This is so because aphids—carriers of the disease—become increasingly active as temperatures rise.

The new spinach was designated Line 214 by its developers—R. E. Webb, ARS plant pathologist at Beltsville, Md., and B. A. Perry, superintendent of the Texas station at Crystal City. Line 214 has uniform green stem color. Also, its leaf type is relatively neutral in its affect on hybrid combinations. When Line 214 is crossed with a savoy or smooth leaf type of spinach, the offspring are primarily savoy.

The new line exhibits good canning, freezing, and fresh-market qualities that also are carried over in crossing. Its seed has a high germination rate.

Line 214 is not considered suitable as a variety for marketing, but is intended only for breeding. It may be crossed with other disease-resistant lines to produce hybrids with multiple disease resistance.

In hybrid combinations with mildew-immune types, the new spinach line was satisfactory when field-tested commercially and by experiment stations in Arkansas, Maryland, Texas, and Washington. Line 214 was also satisfactory in commercial field tests in California and New Jersey.☆

MULCHES MAY KEEP MANGANESE FROM CORN

■ Mulches may decrease the availability of manganese needed for early growth of corn in humid areas, USDA-Iowa studies indicate.

Crop-residue mulches do a good job of reducing erosion and increasing capacity of soils to absorb and hold water. But these benefits are frequently offset by retarded growth of young corn plants and consequent reduction in grain yields.

Several factors may cause poor response

Research indicates that several things are involved in this unfavorable response. The low temperatures of mulched soil is one (Agr. Res., June 1957, p. 15). A deficiency of manganese may be another.

ARS soil scientist D. T. Parker, working with the Iowa Agricultural Experiment Station, found that corn plants grown in soil with a mulch contained much less manganese than those grown in soil with crop residues plowed under.

For example, mulched corn plants sampled 25, 34, and 41 days after planting contained 81, 32, and 34 parts per million (ppm) of manganese, respectively. But plants grown in soil with plowed-under residues had 145, 69, and 40 ppm of manganese at the same respective ages.

The tremendous difference in the amounts of manganese at the first two sampling dates suggests that a deficiency of this nutrient may account for the slow growth made by mulched corn early in the season.

Soil manganese in the mulched soil probably was oxidized into unavailable forms by micro-organisms decomposing the residues. Many more manganese-oxidizing bacteria were in mulched than in unmulched soil.

Manganese application may be necessary

All the young corn plants in the Iowa tests contained relatively high levels of manganese. And the soils have not been known to require manganese fertilization. Parker says, however, that soils known to be low in this mineral would likely become deficient if mulched for corn production. In such areas, he suggests that farmers either include extra manganese in the fertilizer or apply it directly as a foliage spray.☆

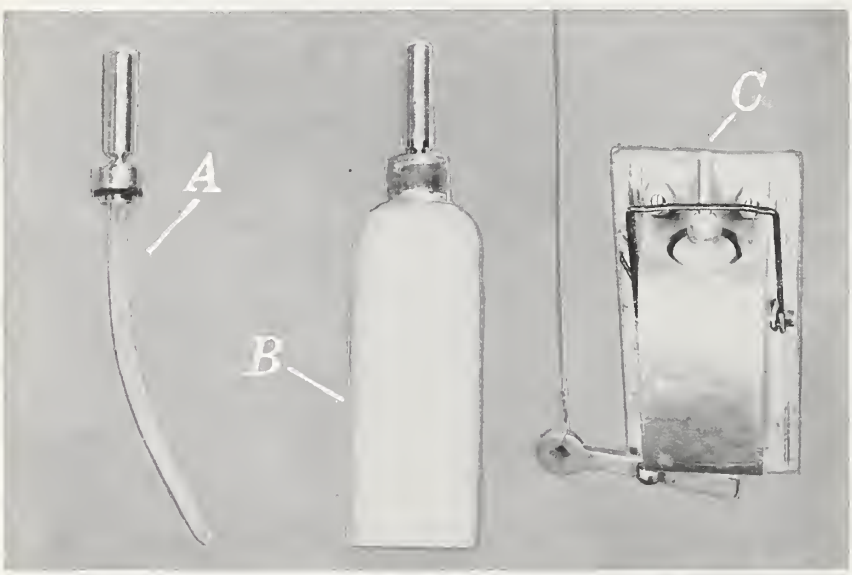
Aerosol device kills

PLANE-RIDING INSECTS

It sprays efficiently when operated automatically or by remote control

Insecticide from aerosol sprayers, almost unnoticed by passengers, fully penetrates plane interior.

This small one-shot container has enough insecticide and propellant to treat 1,000 cu. ft. of space.



The eduction tube (A) of the aerosol dispenser is made from small-bore polyethylene tubing with "break-off" tip valve attached. The tube and valve are in place in 10 cc. container (B). Mouse-trap spring is set to break off valve tip (C) when pilot presses button to release insecticide.

■ More complete control of undesirable insect stowaways inside planes is now possible, thanks to a new device developed by USDA researchers.

The device sprays insecticides, automatically or by remote control, from small aerosols. Each is designed to treat 1,000 cubic feet of space. Sprayers are distributed to apply dosages evenly and exactly.

ARS researchers who developed the device foresee its use in military and commercial aircraft on international flights and in domestic planes flying from areas where agricultural pest quarantines are in effect.

The device may eventually prove useful in trains, buses, ships, stores, bakeries, grain-handling establishments, and other places where fixed, automatic spraying is needed.

For many years planes have been sprayed by hand, with pushbutton-type aerosols, upon entering the United States to prevent introduction of undesirable insects. This hasn't always been effective, because hand-spraying is uneven and doesn't reach all parts of a plane.

The new device killed all caged and free-flying yellow fever mosquitoes in a 2,000 cubic-foot fuselage. Researchers used 100 milligrams of allethrin per 1,000 cubic feet.

Passenger discomfort will be minimum

Public health regulations require treatment while passengers are on board to prevent accidental transportation of insects that are health hazards. Placing aerosols high in planes will reduce to a minimum any human discomfort due to spray.

Formulations of insecticides for these treatments were developed by our scientists in cooperation with the U.S. Public Health Service. The scientists are A. H. Yeomans, engineer; R. A. Fulton, chemist; and W. N. Sullivan, entomologist. Sullivan was one of the men who developed the original aerosol bomb in 1941.☆

Controls budworms and hornworms

Tobacco budworms and hornworms were controlled experimentally by dried spores of *Bacillus thuringiensis*. This bacterium causes a fatal disease of these insects, but is harmless to warm-blooded animals.

A cornmeal bait containing the spores, applied by hand to the growing tips of tobacco plants, controlled both pests in recent experiments of entomologists of ARS and North and South Carolina Agricultural Experiment Stations. The studies showed that the spore-cornmeal bait is as effective, or more effective, than the best chemical spray (endrin) now used to control these pests on tobacco.

Budworms are treated with 1 part of *B. thuringiensis* (90 billion spores per gram) to 99 parts of cornmeal. The material is applied biweekly in 4 applications at the rate of about 12.5 pounds of bait per acre.

Use of *B. thuringiensis* is not yet recommended by USDA—until further research is completed—on tobacco or vegetable crops subject to damage by hornworms. Research is underway to determine formulations that are safe to use on tobacco.

Imported equines now quarantined

To protect against the introduction of African horse sickness, USDA now requires a 30-day quarantine of horses, donkeys, mules, and zebras imported from Africa, Asia, and the Mediterranean area.

The deadly foreign disease has recently spread from Africa—where it was confined for many years—to most countries of the Near East and Middle East. There's a serious threat of further spread throughout the Mediterranean area.

The insect-transmitted disease has never invaded the United States. To guard against that possibility, however, importers are required to hold equines in insect-proof facilities (approved by ARS) for the 30-day observation period. Prior to the recent quarantine, equines weren't detained after passing physical checks and blood tests.

The disease is extremely infectious and deadly, but isn't considered contagious from animal to animal. Vaccines are used in efforts to control the disease.

Root knot doesn't affect NC 95

Seed of NC 95—the first flue-cured tobacco with resistance to the highly destructive root-knot nematode—will be available to farmers from dealers for the 1961 planting season. Its use, along with recommended cultural practices, should greatly reduce the need for soil fumigants to control nematodes attacking tobacco.

The new variety, developed by USDA and the North Carolina Agricultural Experiment Station, is the result of 25 years of breeding research. It marks a victory against the most widely distributed species of root-knot nematode in tobacco-growing areas of the South.

Tests in infested soils showed that NC 95 had no galling or other evidence of root-knot nematode disease. Susceptible tobacco varieties were heavily galled. Even in the absence of the disease, NC 95 yielded about 10 percent higher than Hicks Broadleaf and about the same as the high-yielding black-shank-resistant varieties NC 75 and Coker 316.

When grown under similar conditions, the new variety has flavor equal to NC 75 and Coker 316 and nearly equal to Hicks Broadleaf. Chemical make up of the leaves is similar to Hicks Broadleaf. Nicotine content is higher than in Coker 316.

Initial growth of NC 95 transplants is slow, and the leaves have a characteristic crinkled appearance. Later development is rapid, and the leaves become smooth as they mature. Plants are of medium height and flower about a week later than Hicks.

The scientists stress that harvesting of NC 95 should be delayed until the leaves are fully mature. And curing should be slow to prevent a greenish color in the butts of the cured leaves.

First cabbage to resist clubroot

Badger Shipper, the first cabbage to show some resistance to clubroot, has been released cooperatively by USDA and the Wisconsin Agricultural Experiment Station.

Clubroot is a soil-borne fungus disease that causes serious difficulties in many cabbage-growing areas of the world. Cabbage plant roots are abnormally enlarged by the disease, causing the plants to become stunted and eventually die. The new variety is also resistant to yellows, another soil-borne fungus disease. Infected plants turn yellowish-green, wilt, and may die.

Badger Shipper is not resistant to all strains of clubroot, but it is re-

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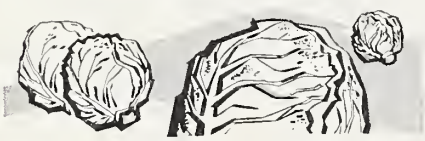
sistant to those strains most prevalent in the U.S.

Heads of Badger Shipper are about the same size as those of Badger Ballhead and are ready for harvest about the same time as Globe. Heads of Badger Shipper are globular to very slightly oval: the outer leaves are smooth, bluish-green, and have medium frilled margins. Leaves are



crisp and have a mild sweet flavor.

It was developed by plant pathologists R. H. Larson of ARS and J. C. Walker of the Wisconsin station.

To check resistance and suitability in specific areas, the scientists suggest that growers test-plant small quantities of the new cabbage before planting on a larger scale.

Pellets protect maple tapholes

Germicidal pellets that protect maple tree tapholes against harmful micro-organisms, thus promising to greatly improve the quality of maple sirup, have been developed by State and USDA scientists.

During the maple sap harvest, micro-organisms often grow in tapholes, fermenting the sap. As a result, light, delicately flavored sirup can't be made from it. The microbial growth also stops the flow of sap early—reducing potential yield.

The pellets—made from paraformaldehyde—are inserted in the tapholes to control the growth. Repeated experiments show that such protection results in sap that can be evaporated to sirup of uniform high quality throughout the maple season.

Research was initiated several years ago when ARS chemists of the Eastern utilization division, Philadelphia, Pa., discovered the cause of the fermenting. The pellets were designed and developed at the Michigan Agricultural Experiment Station, East Lansing, by scientists working under ARS contract in cooperation with the Philadelphia chemists.

Continuing research is aimed at determining the best size and shape for the pellets, the type of binder that should be used, and the storage life of the pellets.

On the basis of experimental evidence, the Food and Drug Administration has expressed the opinion that the use of the pellets does not contribute any residues to maple sirup. Therefore, the paraformaldehyde pellets are not a food additive for the described use within the meaning of the Food Additive Amendment of the Food, Drug, and Cosmetic Act.

Oil bleaching method is improved

An improved method of bleaching cottonseed oil has been devised by USDA scientists. A substance known as activated alumina (aluminum oxide) is used as a bleaching agent in conjunction with higher bleaching temperatures than those now used.

Excessive color is left in about 25 percent of the cottonseed oil produced in the U.S., using conventional refining and bleaching processes. This lowers the selling price of the oil and makes it undesirable for uses where colorless oil is needed.

Tests demonstrated that activated alumina is many times more efficient than the natural bleaching earths now used, report ARS chemists of the Southern utilization division in New Orleans, La.

They also showed that activated alumina bleaches oil successfully when it's used in conjunction with higher

processing temperatures. The higher temperatures had no adverse effect on oil properties.

Initial cost of activated alumina is greater than that of natural earth, but alumina can be reused often. Research is continuing on developing means of reducing the cost of the improved method.

The process has little or no effect on green pigments that occasionally cause a color difficulty in the oil. However, green pigments can be removed rapidly and effectively with activated charcoal.

Pilot plant tests are now being planned to provide more complete information on effectiveness of the new alumina process in large runs and on production costs.

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